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(54) **Process for producing a filter element.**

(57) A process for producing a filter element having a hollow body composed of thermoplastic synthetic fibers and having each of its end surfaces sealed, which process comprises placing on a hot plate (5), provided with a layer of a thermally conductive and releasing surface material (6), in succession, a thermoplastic sheet (7) and a filter element (4) so that an end surface of the filter element contacts the thermoplastic sheet and heat-bonding the end surface of the filter element to the thermoplastic sheet, and repeating the operation for the other end surface of the filter.

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Description

Process for producing a filter element

This invention relates to a process for producing a filter element. More particularly it relates to a process for producing a filter element for precision filtration obtained by molding collected mass of synthetic fibers into a hollow body.

A conventional cartridge filter element has a hollow form opened at both the ends thereof and comprise porous materials such as collected mass of fibers, which is called "depth-type" hereinafter. Fig. 3 shows a cross-sectional view of a conventional depth type cartridge filter element provided in a housing. In the case where water to be treated A is filtered with such a filter element, a filter element 4 is set to the inside of a housing 2, followed by pressurizing a fluid to be treated A into the housing 2 and causing the fluid to penetrate from the outside of the filter element toward the inside thereof. At a lower part and an upper part inside the housing 2 are provided projections (housing-sealing parts) 2A for fixing the filter element 4 and sealing it. The treated fluid B subjected to filtration treatment during penetration through the inside of filter element is taken out from one end of the housing 2 to the outside of the system.

In order to make full use of filterability of the filter element, it is desired that the end surface 1 of the filter element 4 be completely sealed relative to the housing 2, but actually the sealability of the filter element relative to the housing is inferior so that the expected filtrability cannot often be obtained. For example, in Fig. 4 showing a partly enlarged cross-section of the IV part (the sealing part of the filter relative to the housing) in Fig. 3, the fluid to be treated A having intruded from the end face 1 of the filter element 4 makes a detour around the housing-sealing part 2A and passes through the shortest flow path 3 where the pressure loss is minimum to thereby damage the filtration accuracy of the depth type cartridge filter. In order to prevent the fluid from passing through such a shortest flow path, it has been tried to bond a preliminarily molded end cap or punched sheet-like material onto the end surface of the filter element with an adhesive or a hot-melt adhesive.

According to such a process, however, there are drawbacks that it is difficult to control the quantity of the adhesive or hot-melt adhesive adhered at the time of the bonding, or if the adhesive or the like penetrates too deeply into the end surface, the filtration area of the filter is reduced to lower its filterability. Further, there is a problem that hands of workers or the filter is liable to become dirty with the adhesive or the like at the time of bonding operation.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a process for producing a filter element which makes it possible to simply and efficiently seal the end surfaces of the filter element without relying on conventional use of adhesives which require control of the quantity of the adhesives adhered and cause dirt.

The present invention resides in;

a process for producing a filter element having a hollow body composed of thermoplastic synthetic fibers each of the end surfaces thereof being sealed, which process comprises placing on a hot plate as a heat source, by the medium of a thermally conductive and releasing surface material thereon, a thermoplastic sheet and a filter element in this order so that each end surface of said filter element is contacted with said thermoplastic sheet and heat-bonding the end surface of said filter element to said thermoplastic sheet.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a side view illustrating an embodiment of a process for producing a filter element according to the present invention.

Fig. 2 shows a partial cross-section illustrating an anchor effect in the case where a thermoplastic sheet in the present invention has been melted.

Fig. 3 shows a cross-section illustrating the state where a conventional depth type cartridge filter element is set to the inside of a housing.

Fig. 4 shows a partly enlarged cross-section of the encircled IV part in Fig. 3.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Examples of the thermoplastic synthetic fibers constituting the cartridge filter element (hereinafter referred to filter element) usable in the present invention are polyolefin fibers, polyamide fibers, polyester fibers, acrylic fibers, hot-melt adhesive composite fibers obtained by combining the fiber components of the foregoing fibers, etc. Among these, hot-melt adhesive composite fibers are particularly preferred.

Further, the thermoplastic sheet usable in the present invention is preferred to be of the same component as or a similar component to the synthetic fiber component (particularly to the sheath component of the fibers in the case of a sheath-core composite fibers) constituting the filter element, but the sheet may be those composed of a component having a lower melting point than that of the component constituting the filter element. The thermoplastic sheet and the end surface of the filter element are heat-bonded such that at least a portion of the sheet is melted by the heat generated by the hot plate as a heat source and adhered onto the

end surface of the filter element. When the melting point of the component of the thermoplastic sheet is lower than those of the respective components constituting the filter element, the molten part 8 of the sheet flows between the surface layer fibers 9 of the end surface of the filter, as shown in Fig. 2, and cools and solidifies at this state as it is, so that the thermoplastic sheet is more firmly adhered onto the end surface of the filter element due to an anchor effect.

The thermoplastic sheet is heat-bonded to the end surface of the filter element to seal this part, and on the other hand, when the element is set to the housing of the filtration apparatus, the other surface of the material is contacted tightly onto the inner wall of the housing (or the projected sealing part thereof) to seal so as to prevent the short pass of the water to be treated. Thus, the thermoplastic sheet is preferred to have a suitable thickness for affording cushoning characteristics as well as hot-melt adhesive properties, and a shape stability. This thickness varies depending on the size of the filter element, but it is generally 100 μm to 2 mm, preferably 100 μm to 1 mm. In the case where the cushoning characteristics are more required, it is also possible to use a composite sheet having the thermoplastic sheet combined with an elastic sheet such as rubber sheet.

Further, as to the terms "by the medium of a thermally conductive and releasing surface material thereon" referred to herein, such a surface coating may be provided on the hot plate integrally besides a film-form material having these physical properties may be intervene.

The substance forming such a surface material may be those composed of a component which is thermally unchanged or very slightly changed at the melting point of the above thermoplastic sheet. Examples of such a film-form material are cellophane film, polytetrafluoroethylene sheet, polyester sheet, silicone membrane, etc., and these materials may be provided integrally with the hot plate, as described above.

Next, the present invention will be described referring to the accompanying drawings. Fig. 1 shows a side view illustrating a filter element to be placed on a hot plate according to a process of the present invention. In this figure, a film having a thermal conductivity and release characteristics 6 (hereinafter referred to release film) is palced on a hot plate 5, followed by placing on the film 6, a thermoplastic sheet 7 cut to a size somewhat larger than that of the outer diameter of a filter element 4, pressing these materials under a load of F, removing the load after confirmation of the resulted adhesion, cutting off an excess part of the sheet relative to the end surface of the element by means of a cutter and allowing these materials to cool down. The confirmation of the adhesion is experientially carried out referring to the heating temperature of the hot plate, the load and the loading time.

The filter element produced as above-described is set to the inside of the housing 2 as shown in Fig. 3. The end surface of the element is bonded onto the thermoplastic sheet by hot-melt adhesion; hence even if projections 2A of the housing 2 for sealing are not provided, the end surface of the filter element 4 is closely contacted onto the inner wall of the housing 2 due to the cushoning effect of the thermoplastic sheet itself to enhance the sealing effect, and further, since the thermoplastic sheet is heat-bonded onto the end surface of the filter element 4, the fluid to be treated does not form the shortest flow path at this part and hence does not flow therein.

The present invention will be described in more detail by way of Examples.

<u>Example 1</u>

A cellophane film of 50 μ thick as a release film was laid on a hot plate equipped with a temperature controller and set to 175° C, followed by placing thereon a low density polyethylene sheet of 150 μ thick having a melting point of 135° C, placing, after 5 seconds, thereon a cartridge filter element (inner diameter 30 φmm, outer diameter 68 φmm and length 250 mm), the end surface of which being placed on the sheet, molded from hot-melt adhesive composite fibers (ES fiber (trademark of product by Chisso Corporation); core component: polypropylene, sheath component: low density polyethylene, 18 deniers),pressing these materials under a leveled load of 2 Kg/cm² for 10 seconds, heat-bonding the end surface of the filter element to the polyethylene sheet and also heat-bonding the other end surface in the same manner to prepare a cartridge filter element of the present invention. This element was then set to the inside of a filtration apparatus as shown in Fig. 3, followed by passing an aqueous suspension to be treated which was obtained by adding a carborundum powder (having a particle size distribution of 20 to 70 μ to water (the concentration of the suspension: 400 ppm) and agitating these materials, through the element in an amount of the suspension passed of 2,000 ℓ per hour. The filtrate (100 mℓ) having passed through the filter was collected, followed by passing through a filter paper by suction filtration to collect particles and measuring the particle size of the particles. Further, the concentration of the filtrate after continuation filtration for 5 minutes was measured to calculate the percentage removal. The results are shown in Table 1.

<u>Comparative example 1</u>

Using a filter element prepared in the same manner as in Example 1 except that the end surface of the resulting cartridge filter element was not sealed, filtration was carried out in the same manner as in Example 1, followed by measuring the particle size and concentration of the resulting filtrate to calculate the percentage removal. The results are shown in Table 1.

Table 1

	Sealing of end surface	Maximum diameter of particles flown out (micron)	Concentration of dispersion to be treated (ppm)	Concentration of filtrate (ppm)	Percentage removal (%)
Example 1	Yes	52	400	8	98
Comp. ex. 1	No	69	400	9	80

Example 2

Filtration was carried out in the same manner as in Example 1 except that a cartridge filter element molded from composite fibers (polyester fibers) the sheath component of which had a melting point of 180° to 185°C was used, followed by measuring the particle size and concentration of the resulting filtrate. The results are shown in Table 2.

Comparative example 2

Filtration was carried out in the same manner as in Example 2 except that the end surface of the cartridge filter element was not sealed, followed by measuring the particle size and concentration of the resulting filtrate. The results are shown in Table 2.

Table 2

	Sealing of end surface	Maximum diameter of particles flown out (micron)	Concentration of dispersion (ppm)	Concentration of filtrate (ppm)	Percentage removal (%)
Example 1	Yes	51	400	7	98
Comp. ex. 2	No	68	400	75	81

As apparent from the results of the above Examples, the filter element produced according to the present invention is superior in the sealing effect to afford a high percentage removal.

In addition, the low density polyethylene sheet used in the above Examples had a thickness of 150 μ. When the thickness was less than e.g. 100 μ, breakage or wrinkles due to heat shrinkage were liable to be formed, while when it exceeded 300 μ, the end surface hardened to reduce cushoning characteristics and also form clearances between the sealing part of the housing and the filter element so that reduction in the filtration effect was observed.

The cartiridge filter element produced according to the present invention makes it possible to simply and efficiently prevent the fluid to be treated from passing through the shortest flow path along the end surface and also for example if another material layer is provided as media within the filtration layer of the filter, it is possible to prevent the fluid from the end surface, from its detour around the media and its leakage. Further, when the cartridge filter element is produced, no adhesive or the like is used; hence neither hand of worker nor filter element is dirtied and also no contamination of the filter element occurs so that dissolving-out of contaminants into the filtrate does not occur.

Claims

1. A process for producing a filter element having a hollow body composed of thermoplastic synthetic fibers and having each of its end surfaces sealed, which process comprises placing on a hot plate (5), provided with a layer of a thermally conductive and releasing surface material (6), in succession, a thermoplastic sheet (7) and a filter element (4) so that an end surface of the filter element contacts the thermoplastic sheet and heat-bonding the end surface of the filter element to the thermoplastic sheet, and repeating the operation for the other end surface of the filter.

2. A process according to Claim 1, in which the thermoplastic synthetic fibers forming the filter element are hot-melt adhesive composite fibers.

3. A process according to Claim 2, in which the thermoplastic sheet is composed of the same, or a similar, component as the sheath component of the hot-melt adhesive composite fibers.

4. A process according to Claim 1, in which the melting point of the thermoplastic sheet is below the melting point of the thermoplastic synthetic fibers.

5. A process according to Claim 1, in which the thermoplastic synthetic fibers are selected from polyolefin fibers, polyamide fibers, polyester fibers. acrylic fibers, and hot-melt adhesive composite fibers

composed of those fibers.

6. A process according to Claim 1, in which the thermoplastic sheet is composed of the same component as the synthetic fiber component.

7. A process according to any one of the preceding Claims, in which the thermoplastic film has a thickness of from 100 µm to 2 mm.

8. A process according to any one of the preceding Claims, in which the releasing surface material is a cellophane film, polytetrafluoroethylene sheet, polyester sheet or silicone membrane.

9. A process according to Claim 1, in which the thermoplastic fibers are hot-melt adhesive composite fibers composed of polypropylene and low density polyethylene, and the thermoplastic sheet is composed of low density polyethylene.

FIG.1

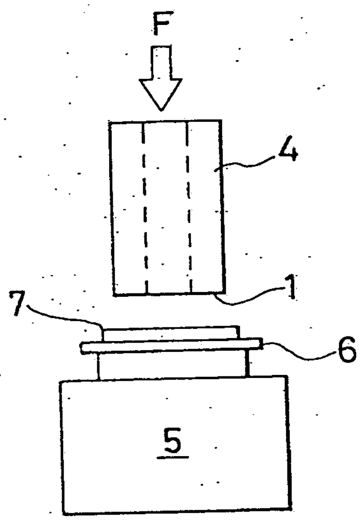

FIG.2

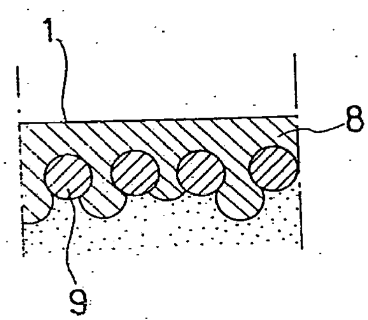

FIG.3

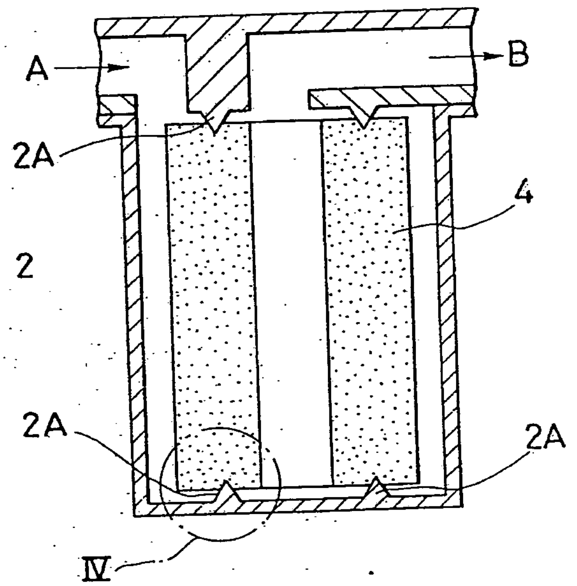

FIG.4